

CLAIMS

1. A knowledge-engineering protocol-suite for facilitating open systems interconnection transactions in a multi-layer knowledge-engineering reference model substantially having

- 5 **Layer 1**—a physical layer for interfacing with apparatus;
 Layer 2—a data-link layer for facilitating data-communications within any of these Layers 1-7 or between any plurality of these Layers 1-7;
 Layer 3—a network layer for maintaining transactional access to data ensembles;
10 **Layer 4**—a transport layer for organizing and maintaining token correspondences and adjacency lists wherein are represented network layer relationships between the data sets or between elements in the data sets;
 Layer 5—a session layer for validating the transport layer represented relationships and for simulating alternative transport layer relationships;
15 **Layer 6**—a presentation layer for designing and executing experimental session layer simulations, evaluations thereof and modifications thereto; and
 Layer 7—an application layer for prioritizing n-tuple strategy dynamics of presentation layer transactions;

wherein the knowledge-engineering protocol-suite includes:

- 20 A) either a structured system having
 I) at least one process-management computer with a program for relating Layers 1-3,
 II) at least one computer embodying a search-space organizational validation method program for relating Layers 3-5, and
25 III) at least one knowledge-engineering workstation with a program for relating Layers 5-7;
 B) or equivalently a distributed asynchronous system of process-modeling computers with programs for relating Layers 1-7.

2. The protocol-suite according to claim 1 wherein the process-management computer or a process-modeling computer includes apparatus interfacing with the physical layer, used by the process-management computer or by the distributed asynchronous system of process-modeling computers, and these apparatus are selected from data-communications devices or process-control machines, and the data-communications devices are for input or data storage or output, and the process-control machines have sensors or program storage or actuators.

3. The protocol-suite according to claim 1 wherein any said program relating to the data-link layer, used by the process-management computer or by the computer embodying a search space organizational validation method or by the knowledge-engineering workstation or by the distributed asynchronous system of process-modeling computers, and used for facilitating data-communications within any of the layers 1-7 or between any plurality of the layers 1-7 as required therein, includes at least one data communications protocol selected from the list:

- A) ISO OSI model type protocol,
- B) inter-net type protocol,
- C) intra-net type protocol,
- D) Wide Area Network type protocol,
- E) Local Area Network type protocol,
- F) Data Base Management System type protocol,
- G) Inter-processor type protocol,
- H) Intra-processor type protocol.

4.The protocol-suite according to claim 1 wherein any said program relating to the network layer, used by the process-management computer or by the computer embodying a search space organizational method or by the distributed asynchronous system of process-modeling computers, and used for maintaining transactional access to data ensembles, includes in said data ensembles

A) a first plurality of correlated empirical data-sets substantially derived from the process-control machines and

B) a second plurality of interrelated nodes of graph-directed expertise-suggested data-set relationships substantially derived from the data-communications devices.

5.The protocol-suite according to claim 1 wherein any said program relating to the application layer, used by the knowledge-engineering workstation or by the distributed asynchronous system of process-modeling computers, and used for prioritizing n-tuple strategy dynamics of presentation layer transactions as required therein, includes performing graph-theoretic orderings of elements or of sets, and said orderings are performed sequentially, in parallel, concurrently, synchronously, asynchronously, heuristically, or recursively.

6.A program storage device readable by a logic-machine, tangibly embodying a program of instructions executable by the logic-machine to perform method steps for validating a search-space organization substantially complying with a knowledge-engineering protocol-suite, said method steps including:

A) organizing a search-space for a first plurality of correlated empirical data-sets, by mapping a second plurality of interrelated nodes of graph-directed expertise-suggested data-set relationships onto the first plurality of correlated empirical data-sets, at least until the second plurality of nodes and relationships substantially includes a predetermined measure of particulars in the first plurality data-sets, wherein data-set resolution of

particulars in the first plurality is greater than or equal to that of particulars in the second plurality; and

B) validating the search-space from a vantage of a presumption of validity for the first plurality of data-sets, by

5 I) simulating a validity-metric for an n-tuple of directed graph components in the mapped second plurality, or

II) measuring if each input to a node of the n-tuple significantly contributes to that node's output, wherein a predetermined convolution of these measurings constitutes a validity-metric for the n-tuple.

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7. An article of manufacture including a computer usable medium having computer readable program code embodied therein for validating a search-space organization and substantially complying with a knowledge-engineering protocol-suite, the computer readable program code in said article of manufacture including:

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A) computer readable program code for causing a computer to organize a search-space for a first plurality of correlated empirical data-sets, by mapping a second plurality of interrelated nodes of graph-directed expertise-suggested data-set relationships onto the first plurality of correlated empirical data-sets, at least until the second plurality of nodes and relationships substantially includes a predetermined measure of particulars in the first plurality data-sets, wherein the data-set resolution of particulars in the first plurality is greater than or equal to that of particulars in the second plurality; and

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B) computer readable program code for causing the computer to validate the search-space from a vantage of a presumption of validity for the first plurality of data-sets, by

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I) simulating a validity-metric for an n-tuple of directed graph components in the mapped second plurality, or

- II) measuring if each input to a node of the n-tuple significantly contributes to that node's output, wherein a predetermined convolution of these measurements constitutes a validity-metric for the n-tuple.

5 8. A process-modeling computer for use in a distributed asynchronous system of process-modeling computers substantially according to a knowledge-engineering protocol-suite, the process-modeling computer logically having three active-units wherein each active-unit has at least one virtual computer processor associated therewith and wherein the active-units
10 are capable of mutual data-communications interaction, and the process-modeling computer includes:

A) a first active-unit of the three active-units, and said first active-unit is further capable of data-communications interaction with

I) sensors or actuators of an associated process-control machine,

15 II) at least one other process-modeling computer in the system of process-modeling computers, and

III) at least one data storage device wherein is collectively represented on at least one memory medium by

20 a) a first plurality of correlated empirical data-sets including at least one data-set of empirical data for the associated process-control machine, and

b) a second plurality of interrelated nodes of graph-directed expertise-suggested data-set relationships by

25 i wherein the second plurality includes a directed graph component to or from a representation for the associated process-control machine, and

ii wherein the data-set resolution of particulars in the first plurality is greater than or equal to that of particulars in the second plurality;

B) a second active-unit of the three active-units, and said second active-unit is capable of organizing a search-space, for the first plurality of correlated empirical data-sets from the vantage of the associated process-control machine, by mapping, the second plurality of interrelated nodes of graph-directed expertise-suggested data-set relationships onto the first plurality of correlated empirical data-sets, at least until the second plurality of nodes and relationships substantially includes

I) a predetermined measure of particulars in the at least one data-set of empirical data for the associated process-control machine, and

II) from the relationships, all directed graph components to or from the associated process-control machine; and

C) a third active-unit of the three active-units, and said third active-unit is capable of validating the search-space by

I) simulating a validity-metric for at least one n-tuple of directed graph components in the mapped second plurality, wherein each said n-tuple includes a directed graph component to or from the associated process-control machine, or

II) measuring if each input to a node of the n-tuple significantly contributes to that node's output, wherein a predetermined convolution of these measurements constitutes a validity-metric for the n-tuple.

9. A distributed asynchronous system of process-modeling computers substantially complying with a knowledge-engineering protocol-suite, the system of process-modeling computers including:

A) at least one process-modeling terminal wherein at least one of the terminals includes a program storage device according to claim 6;

B) a plurality of process-modeling computers wherein each computer is according to claim 8;

C) a data-communications interaction conduit providing sufficient transactional data exchange services

I) between the plurality of process-modeling computers;

II) between at least one of the process-modeling terminals and the plurality of process-modeling computers; and

III) between the process-modeling terminals.

10. A search-space organizational validation method substantially complying with a knowledge-engineering protocol-suite, the method including the steps of:

A) organizing a search-space for a first plurality of correlated empirical data-sets, by mapping a second plurality of interrelated nodes of graph-directed expertise-suggested data-set relationships onto the first plurality of correlated empirical data-sets, *at least until there is a predetermined measure of inclusion by the second plurality of nodes and relationships of particulars in the first plurality data-sets*, wherein the data-set resolution of particulars in the first plurality is greater than or equal to that of particulars in the second plurality; and

B) validating the search-space from a vantage of a presumption of validity for the first plurality of data-sets, by

I) simulating a validity-metric for an n-tuple of directed graph components in the mapped second plurality, or

II) measuring if each input to a node of the n-tuple significantly contributes to that node's output, wherein a predetermined convolution of these measurings constitutes a validity-metric for the n-tuple.

11. The method according to claim 10 wherein **mapping** includes **defining** substantially every node in the second plurality to have at least one graph-directed input and at least one graph-directed output.

12. The method according to claim 10 wherein mapping includes defining substantially every node in the second plurality to have only one graph-directed output.

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13. The method according to claim 10 wherein mapping includes standardizing a format representation for nodes or relationships in the second plurality.

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14. The method according to claim 10 wherein mapping includes representing graph-directed data-set relationships using expertise-suggested initial weightings.

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15. The method according to claim 10 wherein mapping includes representing graph-directed data-set relationships using initial weightings based on statistical process-control generated distribution functions.

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16. The method according to claim 14 wherein validating includes, for at least one weighted directed graph component in the directed graph of second plurality components, improving the weighted component using a validity-metric proportional directed graph component weighting.

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17. The method according to claim 15 wherein validating includes, for at least one weighted directed graph component in the directed graph of second plurality components, improving the weighted component using a validity-metric proportional directed graph component weighting.

18. The method according to claim 16 wherein validating includes generating a conditional statistical process-control distribution function and convoluting the conditional distribution function with the present weightings.

5 19. The method according to claim 17 wherein validating includes generating a conditional statistical process-control distribution function and convoluting the conditional distribution function with the present weightings.

10 20. The method according to claim 10 wherein validating includes, for at least one directed graph component in the directed graph of second plurality components, assigning a validity-metric proportional directed graph component weighting.

15 21. The method according to claim 10 wherein validating includes, for at least one validity-metric above a threshold value, adding a virtual directed graph component to the second plurality.

20 22. The method according to claim 10 wherein validating includes, for at least one validity-metric below a threshold value, deleting a directed graph component from the second plurality.

23. The method according to claim 10 wherein mapping includes updating the first plurality of correlated empirical data-sets.

25 24. The method according to claim 23 wherein updating includes modifying at least one real-time empirical data-set.

25. The method according to claim 23 wherein mapping includes activating an alarm when an updated empirical value is outside of a threshold range.

26. The method according to claim 23 wherein validating includes generating a report having recorded therein an updated empirical value that is outside of a threshold range.

27. The method according to claim 10 wherein mapping includes accumulating empirical data using a data mining engine.

28. The method according to claim 13 wherein standardizing a format representation for nodes or relationships in the second plurality includes either providing for substantially each node in the second plurality: at least one input token; a process token; and at least one output token; or providing for substantially each relationship in the second plurality: a first process token, a linkage token; and a next process token.

29. The method according to claim 10 wherein mapping includes defining a correspondence in the search-space, between the second plurality of interrelated nodes and a process model representation, by performing the steps of:

A) standardizing a format representation for nodes or relationships in the second plurality by

I) either providing for substantially each node in the second plurality:

a) at least one input token;

b) a process token; and

c) at least one output token;

II) or providing for substantially each relationship in the second plurality:

a) a first process token,

b) a linkage token; and

c) a next process token;

5 B) standardizing a format representation for nodes or relationships in the process model by

I) either providing for substantially each node in the process model:

a) at least one input token;

b) a process token; and

c) at least one output token;

10 II or providing for substantially each relationship in the process model:

a) a first process token,

b) a linkage token; and

c) a next process token; and

C) providing correspondence rules between

15 I) tokens of the second plurality and

II tokens of the process model.

20 30. The protocol-suite according to claim 2 wherein any said program relating to the network layer, used by the process-management computer or by the computer embodying a search space organizational method or by the distributed asynchronous system of process-modeling computers, and used for maintaining transactional access to data ensembles, includes in said data ensembles

25 A) a first plurality of correlated empirical data-sets substantially derived from the process-control machines and

